Pollution Prevention Case Study	**The Falk Corporation** **Substitution of oil quench with water-polymer solution in heat-treat pit carburizing operations**
Standard Industrial Classification (SIC)	Speed changers, drives and gears/3566
Type of Waste	Mineral oil liquid
Strategy	Material substitution and process modification
Company Background	The Falk Corporation was established in the Greater Milwaukee Area in 1892 and presently has approximately 1,300 employees at its main plant. Falk produces mechanical power transmission equipment and sells the products worldwide. Products include custom engineered steel castings, enclosed gear drives, open gearing, custom industrial drives, and shaft fluid couplings. Industries served include: cement, mining, automotive, paper, construction, and marine.
Original Process	This case study applies to Falk's pit carburizing of pinions and gears. Quench oil was used to heat-treat (harden) both open-fired and special-atmosphere (carburized) parts in Falk's heat-treat department. Parts are quenched at a temperature of 1525° F.
Motivation	State regulations require that any new process line emitting greater than 3.1 pounds of volatile organic compounds (VOC's)/hour use a capture device with an 85 percent efficiency. For Falk, this device would have required a capital investment of $500,000 to $1,000,000 plus associated energy and maintenance costs. The company sought to avoid these costs and also wanted to reduce drag-out in the quench tank. Falk was also concerned about possible smoke and fire hazards associated with oil quenching of large parts.
Pollution Prevention Process	The pit quench system is a recirculatory system that holds 45,000 gallons of quench media. Pumps circulate the media from a surge tank (20,000 gallon) to the main quench tank (25,000 gallon). Heating and cooling systems are integrated into the process. During a parts quench, agitators circulate the media within the quench tank. The equipment has a maximum capacity of 15 tons, resulting in maximum emissions from the system of 2.17 pounds VOC/per hour which is below the maximum allowable 3.1 pounds VOC/per hour limit. The polymer exhibits virtually no drag-out when removing the parts from the quench tank. Any residual polymer clinging to the quenched part is simply rinsed back into the quench tank with a brief water spray. This system reduces another waste stream (tramp oil at the parts washer) while also reducing costs for purchase of raw material.
Stage of Development	The system is in full use in Falk's pit carburizing facility
Level of Commercialization	Polymer quenchant, which is mixed with water at a ratio of approximately one part polymer to five parts water, has been commercially available for many years. This is the first time that it has been applied to a system this large.

Material/Energy Balance	***Proposed Pollution Control Process*** **Feedstock** 100 percent quench oil **Waste** VOC air emissions and waste oil **Disposal** Wastewater (disposed of offsite by a Waste Management Company). ***Pollution Prevention Process*** **Feedstock** 80 percent H_2O (fresh city water) 20 percent polymer **Waste** VOC air emissions are ~0.144 pounds per ton of steel quenched. **Disposal** None. This is a closed loop system.
Economics	**Capital Costs** Polymer quench system $420,000 7,000 gallons of polymer $200,000 Misc. fixtures, lifting devices $ 20,000 Emergency storage tank $ 20,000 $660,000 **Operation/Maintenance Costs** Not available. **Payback Period** Not calculated. However, the company avoided control equipment and maintenance costs associated with the proposed process. This has resulted in a cost avoidance of ~$542,000.
Benefits	The polymer quenchant, when mixed with water, costs about the same per gallon as the oil quenchant. VOC's are reduced to a fraction of that with oil, and drag-out is virtually eliminated. In over a year of operation, no new raw product has been added to the system.
Obstacles	Until now, polymer quenchant had not been applied to finished carburized gear parts this large. The greatest risk was that parts would crack due to the cooling rate of the quenchant. Falk experimented and found that with the proper concentration and the proper start temperature the cooling curves were similar to oil quenching. Additional features were designed into the system to reduce the risk of cracking.
Technology Transfer	This process has the potential for use in other heat treating application

	systems.
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Pollution Prevention Resources	**Free, On-site Technical Assistance** University of Wisconsin Extension Solid and Hazardous Waste Education Center Milwaukee area: 414/475-2845 Remainder of state: 608/262-0385 **Pollution Prevention Information Clearinghouse** Wisconsin Department of Natural Resources Cooperative Environmental Assistance 608/267-9700 or e-mail: cea@dnr.state.wi.us

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